ANTA 504

Supervised Project in Antarctic Studies

Biosecurity in Antarctica

Adrienne Fortune
0033893

Contents

Introduction

Antarctica has an extremely harsh and unforgiving environment that excludes most life forms. The air temperature is below freezing most of the year and strong winds emphasise the extreme cold. There is also large variation in the hours of light and darkness throughout the year. It is not a hospitable environment for the survival of plant and animal species including humans. There is a limited amount of free running water and 98% of the continent is covered in ice[1].

The conditions in the ocean are better than on the land. Although the conditions are cold, the ocean is abundant with life as the water is warmer than the air temperature[2]. The water temperature remains comparatively constant year round. This is due to reduced wind effect as much of the ocean around Antarctica is covered by ice forming a protective layer. There are also large volumes of nutrients for species to feed on.

Due to the limited ice-free areas in Antarctica the niches for plants and animals are limited. This is further hampered by the fact that some areas are more exposed to extreme weather conditions, further reducing available habitat. There are two plants that grow in Antarctica, *Deschampsia antarctica* (Antarctic grass) and *Colobanthus quitensis* (pearlwort) (McGonigal & Woodworth, 2002; Rubin, 2000). Due to better conditions on the Antarctic Peninsula these species are more common here than elsewhere in Antarctica[3]. These species can tolerate the extreme conditions that are present on the continent and can still photosynthesise at freezing point (McGonigal & Woodworth, 2002).

Other forms of plant life can be found in Antarctica such as algae, mosses and lichens[4]. In Antarctica the animal life consists solely of invertebrates and almost all these belong to the phylum Arthropoda (Rubin, 2000). Species found in Antarctica include mites,

---

[1] www.anta.canterbury.ac.nz/resources/adapt.html accessed on 09/02/05
[2] www.anta.canterbury.ac.nz/resources/adapt.html accessed on 09/02/05
[3] www.anta.canterbury.ac.nz/resources/adapt.html accessed on 09/02/05
[4] www.anta.canterbury.ac.nz/resources/adapt.html accessed on 09/02/05

springtails and midges (Rubin, 2000). There are species that breed south of the Antarctic Convergence including seven of the 17 extant penguin species. The Southern Ocean is full with life including fish, seals and whales (Rubin, 2000).

A number of countries have bases in Antarctica. This includes New Zealand, the USA, Australia, Italy, Russia, South Africa, Chile, Britain and France. With so many countries from around the world having bases in Antarctica there is substantial traffic between Antarctica and the rest of the world. This movement establishes a pathway for the introduction of non-indigenous species into Antarctica.

This study looks at the risk of incursions into Antarctica and the surrounding areas and identifies some examples of the biosecurity problems that have occurred. It will also explore measures that are being taken to prevent incursions and whether these are likely to be sufficient.

Background

Antarctica is a unique environment. It possesses a unique climate, species and therefore presents distinctive challenges. Antarctica is a barometer to how the rest of the world is going. Antarctica has indicated the impact that climate change and humans have had on the planet. For example Antarctica has provided important information on the effects of ozone depletion as it has no population causing ozone depleting agents but the ozone hole still impacts the Antarctic environment. The Antarctic Continent and the knowledge learnt from carrying out science there has had a worldwide effect. Following research in Antarctica numerous international collaborations have come into force to reduce the impact of the human footprint and slow down global warming.

Antarctica has important plant and animal species both terrestrial and marine based. These species are important to the food chain and essential for the survival of many larger species such as whales.

There is significant international collaboration which enables the successful science programmes that are based in Antarctica. New Zealand, Italy and the United States of America (USA) are all involved in a logistical pool that involves interaction between all three Antarctic science programmes. This involves the sharing of resources such as transport planes and ships, landing strips and medical evacuation (Medevac) support. Both the United States Antarctic Programme (USAP) and the Italian Antarctic Science Programme are based at the International Antarctic Centre in Christchurch, New Zealand. Large numbers of scientists and staff of these programmes pass through New Zealand to travel to the Antarctic which potentially increases the risk of contamination between bases and between countries.

What is biosecurity?

There are a number of definitions of biosecurity. New Zealand's definition or understanding of biosecurity has evolved. Early definitions of biosecurity referred to the management of risk arising from pests, weeds and diseases, whether exotic or endemic. Definitions then moved to focus on the cost-effectiveness of protecting any natural resource from organisms capable of causing unwanted harm. The most recent definition relates to the protection of people and natural resources, including biodiversity, from unwanted organisms capable of causing harm (H. Cochrane pers. comm., 2004).

The definition used by the New Zealand Government in the Biosecurity Strategy (2003) incorporates aspects of all three of the above mentioned definitions.

> *"Biosecurity is the exclusion, eradication or effective management of risks posed by pests and diseases to the economy, environment and human health."*

The Biosecurity Act (1993) was the worlds first law which was enacted to specifically protect the introduced and indigenous species within New Zealand from the negative impacts of exotic pests and diseases (New Zealand Government,1993).

Often Antarctica is mentioned specifically within New Zealand legislation; for example the Antarctica Act (1960) which includes the New Zealand Crimes Act (1961). However Antarctica is not included within the biosecurity provisions of the Biosecurity Strategy (2003). This leaves this unique environment vulnerable to the introduction of pests and diseases.

What are we trying to protect Antarctica from?

Humans have the potential of having a significant impact on the Antarctic landscape. In order to protect this unique environment steps need to taken to mitigate the human impact on Antarctica. This can be done by ensuring that daily activities and research do not destroy or pollute the natural features of Antarctica. It can also be achieved by ensuring that the environment is not affected by the introduction of harmful species by base staff, scientists and other visitors to the continent.

Human presence on the Antarctic continent is relatively recent. Explorers from the Heroic Era such as Captain Robert Falcon Scott, Roald Amundsen and Sir Ernest Shackleton first visited this continent approximately 100 years ago. Since this early exploration there has been an increasing trend of interest and activity in Antarctica. There was growing recognition by the mid 20th century that some form of control needed to be introduced to protect Antarctica. Regulations set out by the Antarctic Treaty (1959) and laws enforced on the activities by each member State have greatly modified the behaviour of those researching and visiting Antarctica. An example can be seen in the prohibition of introduced species into Antarctica including dogs and horses.

Regulations

Humans and their activities are controlled within Antarctica by a variety of different measures, protocols and legislation. The umbrella under which all human activity and intervention in Antarctica occurs is known as the Antarctic Treaty System. Under the Antarctic Treaty System is the Antarctica Treaty (1959), the Agreed Measures (1964), the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)

(1980) and the Protocol on Environmental Protection to the Antarctic Treaty (1991) (also known as the Madrid Protocol).

The Antarctic Treaty was signed on 1st December 1959 in Washington by 12 States, and entered into force on the 23rd June 1961 (Appendix 1). The purpose of the Antarctic Treaty is to ensure

> *"in the interests of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord".*

The Antarctic Treaty does not directly specify biological security although the Convention on the Conservation of Antarctic Fauna and Flora does mention in paragraph 25 that Parties will do the following:

> *"avoid harmful interference with the normal living conditions of native mammals and birds, to control the introduction of non-indigenous species of plants and animals into the Antarctica Treaty area, and to take precautions to prevent the introduction of parasites and diseases into the area."*

The CAMLR (1980) does not make any comment on the protection of marine life and the introduction of non-indigenous species.

The Madrid Protocol (1991) was introduced in order to replace the Agreed Measures and provide a comprehensive approach to the protection of the Antarctic environment. The Protocol:

- designates Antarctica as a 'natural reserve, devoted to peace and science'
- establishes environmental principles for the conduct of all activities
- prohibits mining
- subjects all activities to prior assessment of their environmental impacts
- provides for the establishment of a Committee for Environmental Protection, to advise the ATCM

- requires the development of contingency plans to respond to environmental emergencies
- provides for the elaboration of rules relating to liability for environmental damage.

All member states of the Antarctic Treaty are bound not only by the International Law mentioned above but also by domestic legislation. For example New Zealanders are bound by the Biosecurity Act (1993) and the Antarctica (Environmental Protection) Act (1994).

The aim of the Biosecurity Act (1993) is to exclude unwanted organisms from New Zealand. The Act does not allow the importation of plants, animals or animal products without a permit. This also applies to mediums which could carry unwanted organisms such as water and soil.

The purpose of the Antarctica (Environmental Protection) Act (1994) was to protect the Antarctic continent and maintain the importance of the area for scientific research. Under this Act the Ministry of Foreign Affairs and Trade (MFAT) has responsibility for enforcing the law which prohibits the following activities occurring without permission[5]:

- entering or carrying out activities in a protected area;
- taking or attempting to take any native bird or mammal;
- removing or damaging native plants in quantities which significantly affect local distribution or abundance;
- harmfully interfering with native plants, mammals, birds or invertebrates;
- introducing any species of animal, plant or micro-organism not native to that area;
- importing non-sterile soil.

Another example of individual States introducing policy to protect the Antarctic continent is from Australia. The Australian Antarctic Division (AAD) has decided to take strict approach to the protection of the Antarctic environment. Their policy is based on

[5] http://www.antarcticanz.govt.nz/article/3284.html#4048 Accessed on 13/02/05

the motto *"Take it new or keep it clean"*. They believe that in order to protect Antarctica strict quarantine method for all tourists, scientists to sub-Antarctic and Antarctic stations are necessary. Due to an earlier discovery of soil, insects and various types of plant material amongst cargo the AAD has improved their cargo handling practises and Quarantine officers appointed to each voyage. For example at the sub-Antarctic Heard Island AAD has modified their clothing in order to protect the 'pristine environment'. This includes using only new clothing, no velcro as this attracts seeds, no open weave mesh as it can trap seeds, soil and insects and designing clothing to minimise seed traps and facilitate easy cleaning[6].

Pathways of Introduction

The pathways for introducing undesirable species and diseases to Antarctica are:

- People
- Ships
- Ballast water
- People
- Tourists on cruise ships
- Cargo

There is substantial interaction between different countries on the Antarctic Continent. For example Italy, USA and New Zealand are all involved in a logistical pool. This involves cooperation in transporting passengers and cargo to the ice by ships and planes. There is also a lot of interaction between bases. For example, the movement between Scott Base (NZ) and McMurdo Station (USA) by people and transport is free and with staff and scientists allowed to move around and between buildings with only limited restrictions. Christchurch is considered the Gateway to Antarctica which means that there is a large number of people and cargo passing through New Zealand to and from Antarctica. This high level of movement and interaction of humans and cargo increases

[6] www.aad.gov.au/default.asp?casid=5437 Accessed on 09/02/05

the risk of undesirable diseases and pests being introduced into Antarctica and New Zealand.

Humans now live and work in Antarctica 12 months of the year. Buildings have been designed to withstand the extreme weather conditions of the Antarctic. The heated buildings give an environment in which life is more readily supported. This means that some species may make there way to Antarctica with humans and may now be able to survive within the bases, in this normally harsh environment.

There are a number of pathways noted for the dispersal of exotic species in marine environments. These include ballast water, biofouling adhering to ships, floating anthropogenic debris (Tavares and De Melo, 2004). Ballast water has been proven to be a very effective vector for introducing non-indigenous marine species regionally and internationally (Tavares and De Melo, 2004). There are large numbers of ships travelling to Antarctica such as tourists, fishing and scientific research (e.g. carrying out oceanographic activities) vessels which increases the risk of the introduction of exotic species to Antarctic waters (Tavares and De Melo, 2004).

Case Studies

Three cases from three different areas have been chosen to illustrate biosecurity issues that are occurring in Antarctica. The first looks at plant biosecurity risks, the second at marine and the third human health.

Plant

In December 2002 the hydroponics facility at Scott Base was quarantined due to the accidental importation of springtails into the unit. It was again quarantined in August 2004 due to a second outbreak possibly due to inadequate cleaning after the initial outbreak (Gilbert, 2005, pers. comm.). It is unclear how they were introduced into the unit but it may have been via a contaminated batch of lettuce or through the exchange of

material with McMurdo who had springtails during the same season. It is unclear which country introduced the springtails into the McMurdo and Scott Base. Antarctica New Zealand never identified the springtail species (Gilbert, 2005, pers. comm.). Since the outbreak the hydroponics unit at Scott Base has remained closed for other reasons (Gilbert, 2005, pers comm.). This example illustrates the fact that outbreaks can occur but in fact has been able to provide very little information on how it occurred or how to successfully deal with these biosecurity risks at initial outbreak.

Marine

One documented example of a marine incursion into the Antarctic is that of the North Atlantic spider crab *Hyas araneus* (Tavares and De Melo, 2004). This is reported to be the first non-indigenous species identified in the Southern Ocean surrounding Antarctica (Tavares and De Melo, 2004). There has been colonisation into almost all marine ecosystems worldwide except for the Southern Ocean (Barnes, 2002). In the case of *H. araneus* the suspected form of introduction into the Antarctic Peninsula is either through the ballast water or on a ship's sea chest (Tavares and De Melo, 2004).

Human Health

Antarctica New Zealand reduces the risk of the outbreak of medical diseases occurring through comprehensive medical examinations prior to arrival in Antarctica. No formal procedures exist specifically for medical outbreaks, but Antarctica New Zealand (Gilbert, 2005, pers. comm.) has indicated that they would follow the standard procedures for any emergency. Antarctica New Zealand would initially seek advice from their own medical advisor located in Christchurch and would then progress to seeking advice from the Ministry of Health if necessary. The McMurdo Station Hospital is also available to those at Scott Base and could provide medical support and/or advice. Due to their location, Scott Base could be isolated with relative ease if the need arose.

A factor that Antarctica New Zealand cannot control are interactions with tourists. Staff and researchers at Scott Base do interact with visiting tourists but Antarctica New

Zealand has no control over the health checks conducted on these people. This exposes staff and researchers to potential diseases. However, at this point Antarctica New Zealand takes a approach of reducing the risk of outbreaks but does not see this as a significant risk. Antarctica New Zealand considers the risk to the environment as more important currently and are focusing on implementing and carrying out measures to protect this unique environment.

Conclusion

Antarctica is a large and unique environment. This is acknowledged by all member States of the Antarctic Treaty System. States such as New Zealand and Australia appear to take their responsibility for protecting the Antarctica environment seriously through the provision of domestic legislation and policy. However there is potential for Antarctica New Zealand to evaluate their current policies and procedures in relation to biosecurity. It would seem that the current policy and procedures need to be examined to ensure that risks to biosecurity are minimised. Past experience of biosecurity breaches could provide invaluable knowledge for future protection and should be re-examined.

Acknowledgements

I would like to thank Dr Neil Gilbert of Antarctica New Zealand for his assistance in providing details on the case studies. I would also like to thank Associate Professor Bill Davison of the University of Canterbury for his assistance on the marine case study.

My thanks to Dr Hamish Cochrane of the University of Canterbury for his invaluable help as my supervisor for this project and willingness to assist with information on biosecurity.

References

Barnes, D.K.A. 2002. Human rubbish assists alien invasions of seas. *Directions in Science,* **1**, 107-112.

Biosecurity Council. 2003. *Tiakina Aotearoa Protect New Zealand: The Biosecurity Strategy for New Zealand.* Biosecurity Council. Wellington. 63 pp

Crossley, L. 1995. *Explore Antarctica.* Cambridge University Press. Cambridge. 112 pp.

McGonigal, D., and Woodworth, L. 2002. *Antarctica the Blue Continent: The Last Great Wilderness on Earth.* Random House. Auckland. 224 pp

New Zealand Government. 1993. Biosecurity Act. New Zealand Government: Wellington.

Rubin, Jeff. 2000. *Lonely Planet Antarctica.* Lonely Planet Publications Pty Ltd. Australia. 376 pp

Tavares, M. and de Malo, G.A.S. 2004. Discovery of the first known benthic invasive species in the southern ocean: the north Atlantic spider crab *Hyas araneus* found in the Antarctic Peninsula. *Antarctic Science,* 16 (2): 129-131

Appendix 1

This table has been reproduced from the Scientific Committee on Antarctic Research (SCAR) website (www.scar.org/treaty/signitories.htm accessed on 3/2/05).

OS = Original Signatory

CP = Consultative party

AS = Acceding State

	Country	Date	Status	Date when Acceding State became Consultative Party
1	United Kingdom	31 May 1960	OS/CP	
2	South Africa	21 June 1960	OS/CP	
3	Belgium	26 July 1960	OS/CP	
4	Japan	4 August 1960	OS/CP	
5	United States of America	18 August 1960	OS/CP	
6	Norway	24 August 1960	OS/CP	
7	France	16 September 1960	OS/CP	
8	New Zealand	1 November 1960	OS/CP	
9	Russia[7]	2 November 1960	OS/CP	
10	Poland	8 June 1961	AS/CP	29 July 1977
11	Argentina	23 June 1961	OS/CP	
12	Australia	23 June 1961	OS/CP	
13	Chile	23 June 1961	OS/CP	
14	Czech Republic[8]	14 June 1962	AS	
15	Slovak Republic[9]	14 June 1952	AS	
16	Denmark	20 May 1965	AS	

[7] Known as the Soviet Union until December 1990.

[8] Succeeded to the Treaty as part of Czechoslovakia which is separated into two republics on 1 January 1993.

[9] ibid

17	Netherlands	30 March 1967	AS/CP	19 November 1990
18	Romania	15 September 1971	AS	
19	German Democratic Republic	19 November 1974	AS/CP	5 October 1987
20	Brazil	16 May 1975	AS/CP	12 September 1983
21	Bulgaria	11 September 1978	AS/CP	25 May 1998
22	Germany, Federal Republic of[10]	5 February 1979	AS/CP	3 March 1981
23	Uruguay	11 January 1980	AS/CP	7 October 1985
24	Papua New Guinea[11]	16 March 1981	AS	
25	Italy	18 March 1981	AS/CP	5 October 1987
26	Peru	10 April 1981	AS/CP	9 October 1989
27	Spain	31 March 1982	AS/CP	21 September 1988
28	China, People's Republic of	8 June 1983	AS/CP	7 October 1985
29	India	19 August 1983	AS/CP	12 September 1983
30	Hungary	27 January 1984	AS	
31	Sweden	24 April 1984	AS/CP	21 September 1988
32	Finland	15 May 1984	AS/CP	9 October 1989
33	Cuba	16 August 1984	AS	
34	Korea, Republic of	28 November 1986	AS/CP	9 October 1989
35	Greece	8 January 1987	AS	
36	Korea, Democratic People's Republic of	21 January 1987	AS	
37	Austria	25 August 1987	AS	
38	Ecuador	15 September 1987	AS/CP	19 November 1990
39	Canada	4 May 1988	AS	
40	Colombia	31 January 1989	AS	
41	Switzerland	15 November 1990	AS	

[10] Became united with the Federal Republic of Germany on 3 October 1990 (now known as Germany).

[11] Succeeded to the Treaty after independence from Australia.

42	Guatemala	31 July 1991	AS	
43	Ukraine	28 October 1992	AS	
44	Turkey	25 January 1996	AS	